Staff Papers Series

STAFF PAPER P78-5 MAY 1978

THE EFFECTIVENESS OF PRICE SUPPORT POLICY--SOME EVIDENCE FOR U.S. CORN ACREAGE RESPONSE

by

Paul Gallagher

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

THE EFFECTIVENESS OF PRICE SUPPORT POLICY--SOME EVIDENCE FOR U.S. CORN ACREAGE RESPONSE*

by Paul Gallagher

INTRODUCTION

The decade of the seventies has brought a new economic environment for farmers' production decisions. Risk, increasing costs and the varying influence of government price support policy vis a vis market prices are important characteristics of this new order. Conceptual frameworks have been presented for assessing producers' reactions to these factors. Moreover, methods for measuring producers' responses to risk and cost inflation have been developed, confirming the significance of these factors.[1/] The role of government support prices in this new environment has received less attention. The intention of this paper is to present a method of measuring price expectation for analyzing supply response when the influence of price support and market phenomena varies with market conditions.

---

*The author gratefully acknowledges comments and suggestions from James Houck, Mary Ryan, Willie Meyers and Maury Bredahl. The usual disclaimers apply.

1/ See Just (1974a) for a review of conceptual frameworks appropriate for incorporating risk, cost inflation and support policy. Just (1974b) and Ryan (1976) provide evidence that risk influences farmers' production decisions. Evans (1977) shows that input cost increases have an effect on U.S. cotton acreage.

PRODUCER PRICE EXPECTATIONS IN THE CASE OF PRICE SUPPORTS - A REVIEW OF SOME CONCEPTS

In analyzing producer behavior under conditions of uncertainty, an accepted view starts with the assumption that producers perceive a probability distrubution on price outcomes. Production then depends on the characteristics of this distribution. In all cases, output and expected price are positively related. And, unless producers are indifferent to risk, supply will also depend on the variance of the perceived distribution.[1/] In line with the findings of other authors, this study will allow for producers' reactions to price risk.[2/] However, the central concern is to elucidate the role of government support and market phenomena in forming producer price expectations.

The existence of price supports suggests a restriction on the probability distribution. In particular, Just (1974a) points out that price supports define a risk floor, below which the price paid to farmers cannot fall. Thus, a probability density function, f(P), would have the following properties

$$\int_{PS}^{\infty} f(P) = 1 \text{ and } PE = \int_{PS}^{\infty} Pf(P).$$

The price support (PS), expected price (PE) and density function, f(P), are illustrated in figure (1a).

1/ See Heady, pp. 439-488.

2/ See Just (1974b), Ryan and Behrman. Also, Appendix A contains a note on alternative specifications of risk models and some of the implications for short run production dynamics.

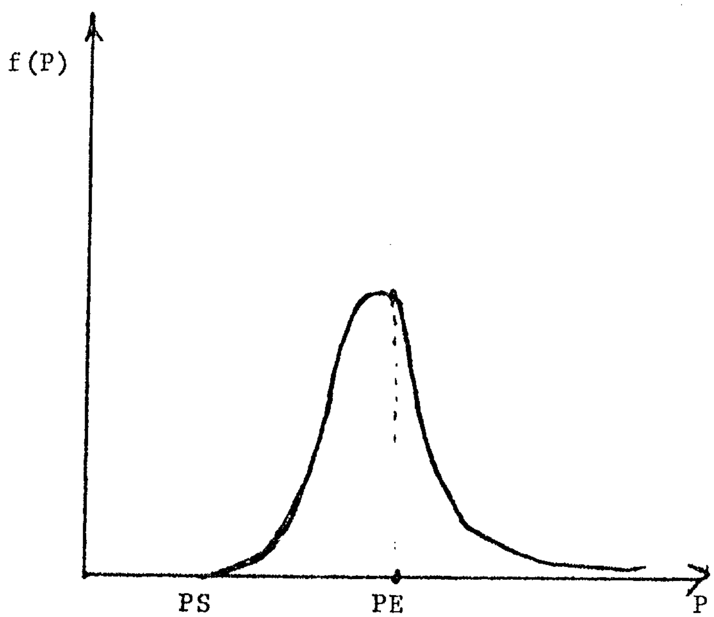

FIGURE (1a)

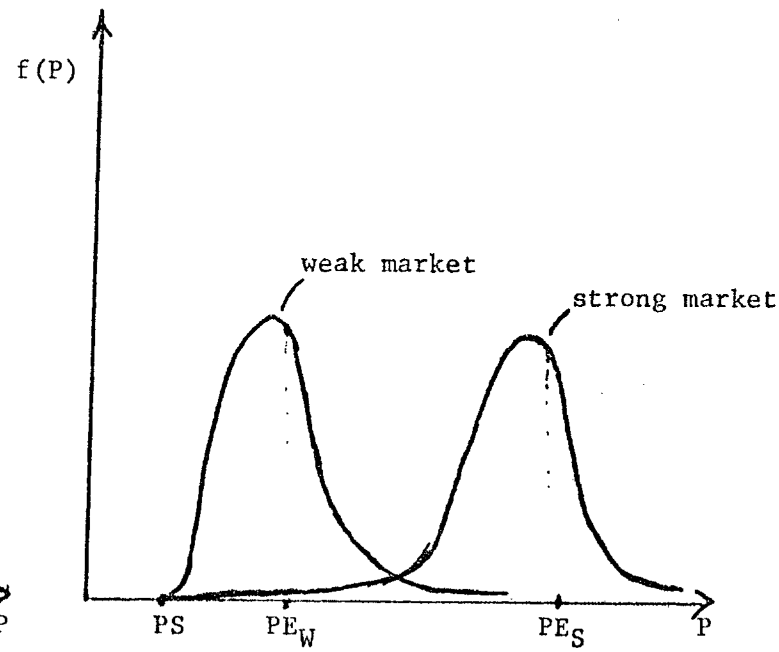

FIGURE (1b)

Other literature contains the assertion that the position of density function, f(P), depends on past market phenomena.[3/] To incorporate market conditions into the discussion, consider strong and weak markets. When the market has been historically weak, f(P) shifts towards the support price. In this case, expected price is very near the support price, and hence, output should depend primarily on support prices. On the other hand, f(P) shifts away from the risk floor when market prices have been substantially above the support price. Under these circumstances, market price should have the predominant effect on output decisions. The strong and weak market cases are illustrated in figure (1b).

[3/] See Just, 1974a, p. 3 for a summary.

A METHOD FOR MEASURING PRODUCER RESPONSE

An appropriate econometric model of producer response would assign the dominant allocative role to support prices under weak market conditions and to market prices under strong market conditions. Moreover, policy analysis would be enhanced if one allows for the possibility that support prices affect producers' decisions even under moderate and strong market conditions.[4/] The method that follows features market price elasticities that strengthen with market surges and support price elasticities that increase as markets weaken.

An estimable production response model requires the statement of a supply relation and an expectations formation mechanism. A linear function is taken to describe the relation between supply (S_t) and expected price (PE_t)

$$S_t = \alpha + \psi PE_t + \varepsilon_t \qquad (1).$$

The expectations formation relation is a rather complicated function of current year support price (PS_t) and previous crop year market price (PM_{t-1})

$$PE_t = PS_t + \gamma[(D_t + 1) \ln (D_t + 1) - D_t] \qquad (2).$$

$$\text{where } D_t = PM_{t-1} - PS_t$$

[4/] Other methods assume that the response to support prices is (1) constant, regardless of market conditions or (2) exclusively determined by market prices when prices are bouyant or support prices when the market is weak--For example, See Houck, et al.

The advantage of this expected price formulation is that the response of expected price to changes in market or support price can be expressed as a simple function of the difference between market and support price (D_t)[5/]

$$\frac{\partial PE_t}{\partial PM_{t-1}} = \beta_t(D_t) \qquad (3a).$$

and $$\frac{\partial PE_t}{\partial PS_t} = 1 - \beta(D_t) \qquad (3b).$$

where $\beta(D_t) = \gamma \ln(D_t + 1)$

For strategic assignments of the parameter γ (i.e., $\gamma > 0$ and not too large), $0 \leq \beta(D_t) \leq 1$. Under these circumstances, supply response to market and support prices can be expressed in terms of the supply response parameter (ψ) and a multiplier ($\beta(D_t)$ or $1 - \beta(D_t)$) which varies with market conditions

$$\frac{\partial S_t}{\partial PM_{t-1}} = \psi\beta(D_t) \qquad (4a).$$

$$\frac{\partial S_t}{\partial PS_t} = \psi[1 - \beta(D_t)] \qquad (4b).$$

[5/] In fact, the expected price equation (2) was obtained by specifying that expected price was an unknown function of PS_t and PM_{t-1} which satisfied (3a) and (3b). The procedure for finding a function given partial derivatives is described by Taylor (p. 437).

The analogous elasticities for support and market prices are

$$e_{S_t} \cdot PM_{t-1} = \frac{PM_{t-1}}{S_t} \psi\beta(D_t) \qquad (5a).$$

$$e_{S_t} \cdot PS_t = \frac{PS_t}{S_t} \psi[1 - \beta(D_t)] \qquad (5b).$$

An examination of the multiplier, $\beta(D_t) = \gamma \ln(D_t + 1)$, verifies that supply elasticities can adjust appropriately with market conditions. Figure 2 illustrates this function when the parameter, γ, assumes positive values. $\beta(D_t)$ is zero, for example, when the market price falls to the risk floor ($D_t = 0$) -- the corresponding elasticities for market and support prices are zero and one, respectively. As market conditions strengthen $\beta(D_t)$ increases, so the market price elasticity increases and the support price elasticity decreases. Finally, a moments reflection suggests some limitations on this approximation to producer behavior. Under the strongest market conditions, it is plausible that producers make their decisions solely on the basis of market prices ($\beta = 1$) and ignore support policy. However, it would be unreasonable to suggest that negative weight is given to support policy ($\beta > 1$). A point on the horizontal axis of figure 2 (D_{max}) shows the limit of this approximation. Given an assignment for γ, price differences beyond this point suggest that farmers place a negative weight on support policy and more than complete weight on market phenomena.

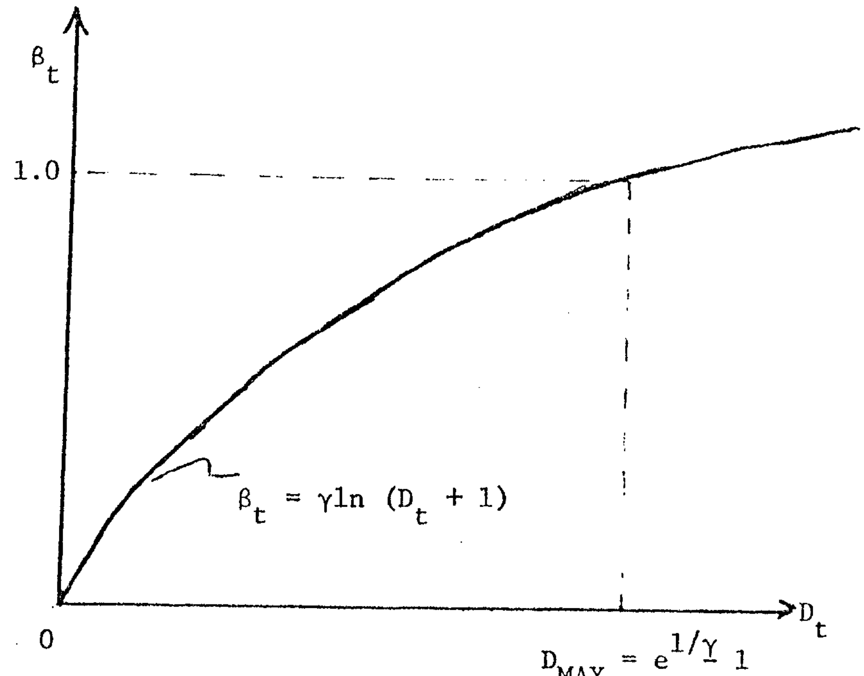

FIGURE 2

METHODOLOGY

The central empirical issue is the extent of producer adjustment between support and market signals as market conditions vary. In the context of the algebraic model, this issue reduces to estimating the value of the parameter γ in equation (2). When the supply and price expectation relations (Equations (1) and (2)) are combined, however, the resulting relation between observable variables is non-linear with respect to the parameters ψ and γ:

$$S_t = \alpha + \psi[PS_t + \gamma(D_t + 1) \ln (D_t + 1) - D_t] \qquad (6).$$

Least squares estimation of (b) would produce the best linear unbiased estimates of α, ψ and $\psi\gamma$ with the usual assumptions about the residuals. In view of the emphasis on obtaining estimates of the structural parameter γ, however, a non-linear maximum likelihood technique is superior, since this procedure would yield unbiased, efficient estimates of α, ψ and γ.[6] Parameter estimates are then obtained with a program that minimizes the sum of squared residuals for a non-linear regression equation--the objective function for this problem is the same as maximum likelihood estimation with the assumption of a normal disturbance term.

ESTIMATES OF U.S. CORN ACREAGE RESPONSE

This section contains an estimated corn acreage relation which utilizes the price expectation equation of the earlier section and builds on previous acreage response research. Previous work on corn acreage is summarized by Houck, et al. These analyses featured effective price support and diversion payment variables for measuring the composite effects of government corn policies. Important crop substitutions were also identified--sorghum and corn competed for land use during the 1950's and a corn-soybean substitution has been significant through the last three decades. Some acreage reducing effects of the seventies are also taken into account. Price risk is measured along the lines suggested by Ryan and cost increases are taken into account by deflating expected price with cost indices.

Table 1 contains two specifications of the basic acreage response model. Both of these equations contain expected prices relative to costs of production for corn and soybeans (PEC_{t}/CAC_{t} and PES/CAS_{t})--the expected price variables are based on estimated values of adjustment parameters (γ_c and γ_s) for corn and soybeans. Both relations also feature corn diversion policy variables (DPC and DV66), a risk term

---

[6] See Kmenta, p. 481.

($RISK_t$) and a variable which measures the 1950's substitution between corn and grain sorghum ($ASGPM_t$). The difference between (1.1) and (1.2) is that the latter equation also contains a lagged dependent variable; this specification is included as a test of the hypothesis that farmers are unable to make complete adjustments when large price changes occur.

The statistical properties of both equations are acceptable. The R^2 statistic exceeds 97 percent in both cases, indicating that either set of explanatory variables provides a good explanation of historical corn acreage variation. Moreover, standard errors are small relative to estimated coefficient magnitudes, suggesting that implications about structure could be drawn from the estimates.

The parameter estimates are generally similar to those obtained in earlier studies, but there are some exceptions. The measured effects of Diversion policy and sorghum substitution are similar to the ones reported earlier. The acreage response to a change in expected corn price is also in accordance with other studies,--elasticity estimates are between 0.1 and 0.2. The response to changes in expected soybean price, however, is smaller than previous. The elasticity estimates in table 1, 0.07 to 0.08, are roughly half the magnitude of earlier estimates. The reduced soybean price effect could be attributed to the risk term, which explains a significant portion of recent corn acreage variation. In fact, the risk estimate (eqn. 1.2) suggests that corn acreage expansions between 1972 and 1975 were about 3.0 million acres less than would have occurred in the absence of risk.

In short, either (1.1) or (1.2) provide an adequate explanation of historical variation. However, (1.2) is probably a more accurate

Table 1. Nonlinear Least Squares Estimates with Corn Planted Acreage (ACP_t) as the Dependent Variable

1954 to 1977 Data   Dependent Variable Mean: 72,993.5

	Constant	$DV66_t$	$ASGPM_t$	DPC_t	$RISK_t$	ACP_{t-1}	$\frac{PEC_t}{CAC_t}$ 1/	γ_c	$\frac{PES_t}{CAS_t}$ 1/	γ_s	R^2	$\bar{S}$	D.W.	ESS
(1.1)														
coefficient	80,475.65	4,838.92	⁻0.40794	⁻64,079.79	⁻3,078.416		687,277.28	0.78356	⁻63,713.36	0.55584	.9746	1288.46		28,222,159.0
std. error	5,839.45	888.69	.16866	7,574.67	1,975.54		191,736.76	0.38980	38,668.88	0.40251				
elas@mean				⁻0.091			0.159		⁻0.080					
(1.2)														
coefficient	75,472.62	4,717.30	⁻0.432111	⁻61,362.73	⁻2,736.37	0.032449	768,859.05	0.888505	⁻51,753.99	0.59775	.9764	1279.99		26,214,080.0
std. error	7,702.00	886.97	.16808	7,830.16	1,968.31	.03657	206,094.67	.47573	42,473.42	0.56276				
elas@mean				⁻0.087			0.178		⁻0.065					

Variable Definitions

ACP_t : U.S. planted corn acreage (thousands)

$DV66_t$: 1, 1966 to 1972; 0, otherwise

$ASGPM_t$: $\frac{ASGP_t\text{, 1954 to 1966}}{ASGP\text{, for previous period, 1961 to present}}$

$ASGP_t$: U.S. Acreage planted to sorghum grains

DPC_t : Corn, effective diversion payment rate (\$/bu.)

PFC_t : Corn, effective price support (\$/bu.)

PMC_t : Corn, U.S. season average price received by farmers (\$/bu.)

CAC_t : Corn, variable costs per acre (\$/acre)

PSS_t : Soybeans, effective price support (loan rate), \$/bu.

PMS_t : Soybeans, U.S. season average price received by farmers (\$/bu.)

CAS_t : Soybeans, variable costs per acre (\$/acre)

$RISK_t$: $\frac{(PMC_{t-1} - MAC_t)^2}{MAC_t}$, where $MAC_t = 1/3(PMC_{t-2} + PMC_{t-3} + PMC_{t-4})$

PEC_t : $PFC_t + \gamma_c [(DC_t + 1) \ln (DC_t + 1) - DC_t]$, where $DC_t = PMC_{t-1} - PFC_t$

PES_t : $PSS_t + \gamma_s [(DS_t + 1) \ln (DS_t + 1) - DS_t]$, where $DS_t = PMS_{t-1} - PSS_t$

representation, since this equation contains the lagged variable, which is statistically significant.

CORN PRODUCERS' RESPONSE TO SUPPORT AND MARKET PRICES:

As shown, the parameter γ determines the extent of producer adjustment between support and market price. That is, γ-estimates determine the magnitude of the adjustment weight (β) for given market conditions. In turn, β determines support and market price elasticities. Estimates of the adjustment between government and market prices for corn and soybeans are presented below.

Corn and soybean adjustment functions are illustrated in figures (3a) and (3b), where β estimates are plotted against the difference between market and support prices (D). Specific values of D are also indicated on the horizontal axes: (1) mean values for a period of high support and moderate market prices (1969-72), (2) mean values for a period of strong market and low support prices (1973-76) and (3) the maximum difference between support and market prices. During the early period, market prices had a moderate effect--β values were around .25 for both commodities. In contrast, both β values were near one at the height of the 1970's price explosion. However, even at average values from the high price period, support prices still had a moderate effect on acreage response. This tendency is more pronounced in the case of corn, where only 60% weight is assigned to market price changes.

Table 2 indicates the extent of corn producer response to support and market prices as market conditions vary. Corn and soybean price elasticities are computed for the three types of market conditions indicated in figures (3a) and (3b). The corn elasticities suggest that support and market prices both retain an allocative role under strong and weak market conditions. The ratio of support to market price elasticities is about 2:1 for weak markets and 1:3 for strong markets. The market elasticity dominates only under the strongest market conditions. The soybean response estimate suggests a more complete adjustment between support and market signals. The support/market ratio is around 5:1 for weak markets and 1:7 for strong markets. Moreover, support price had virtually no effect when soybean prices were strongest.

FIGURE 3A. Corn - Market Price Adjustment Weight (β_c) vs Difference between Market and Support Price (D_c)

$\beta_c = 0.888505 \ln(DC_t + 1) \cdot \beta_c = 1.0$ when $D_c = \$2.08$/bu.

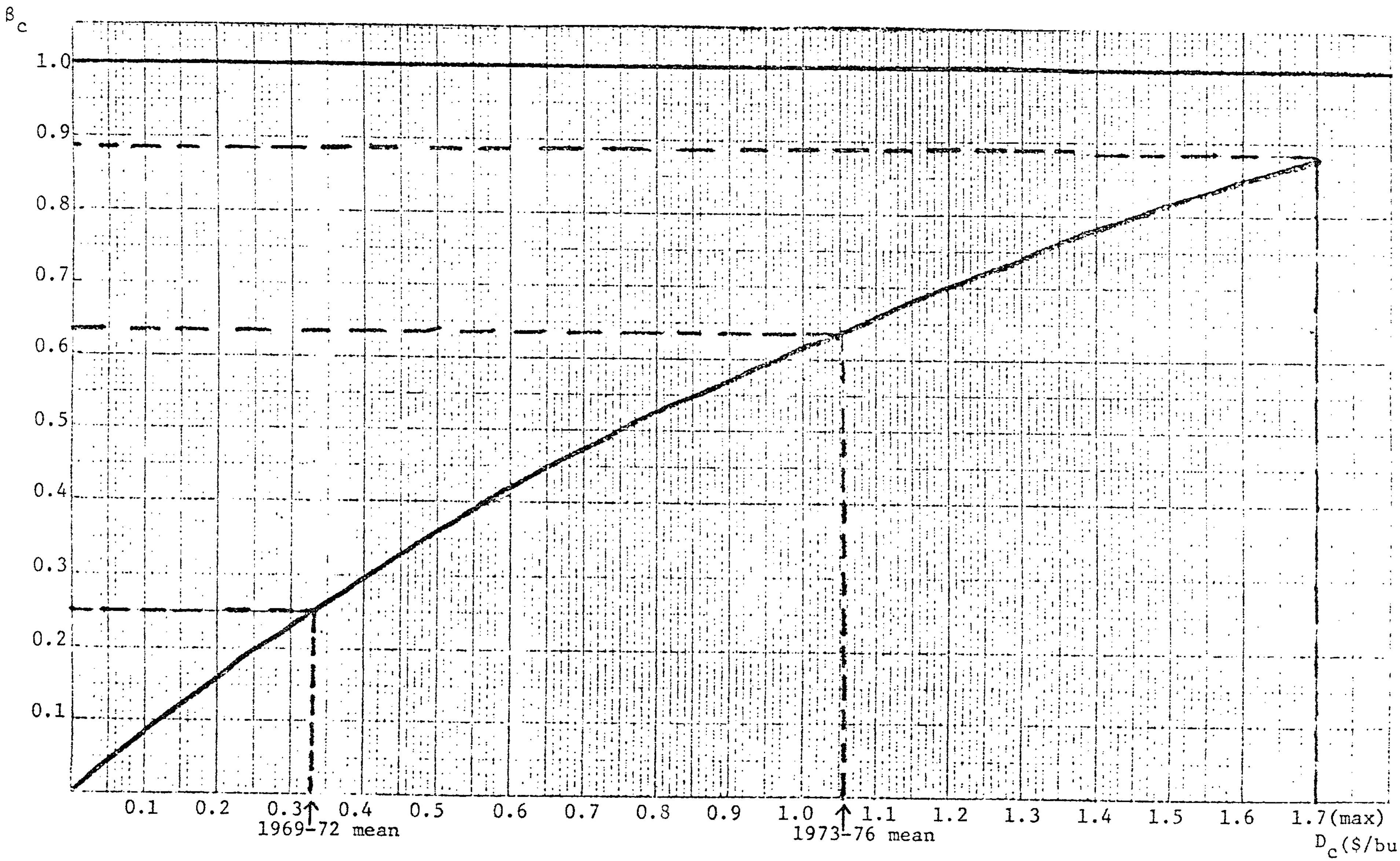

FIGURE 3B. Soybeans - Market Price Adjustment Weight (β_s) vs Difference between Market and Support Price (D_s)

$\beta_s = 0.59775 \ln(D_{s_t} + 1) \cdot \beta_s = 1.0$ when D_s = \$4.33/bu.

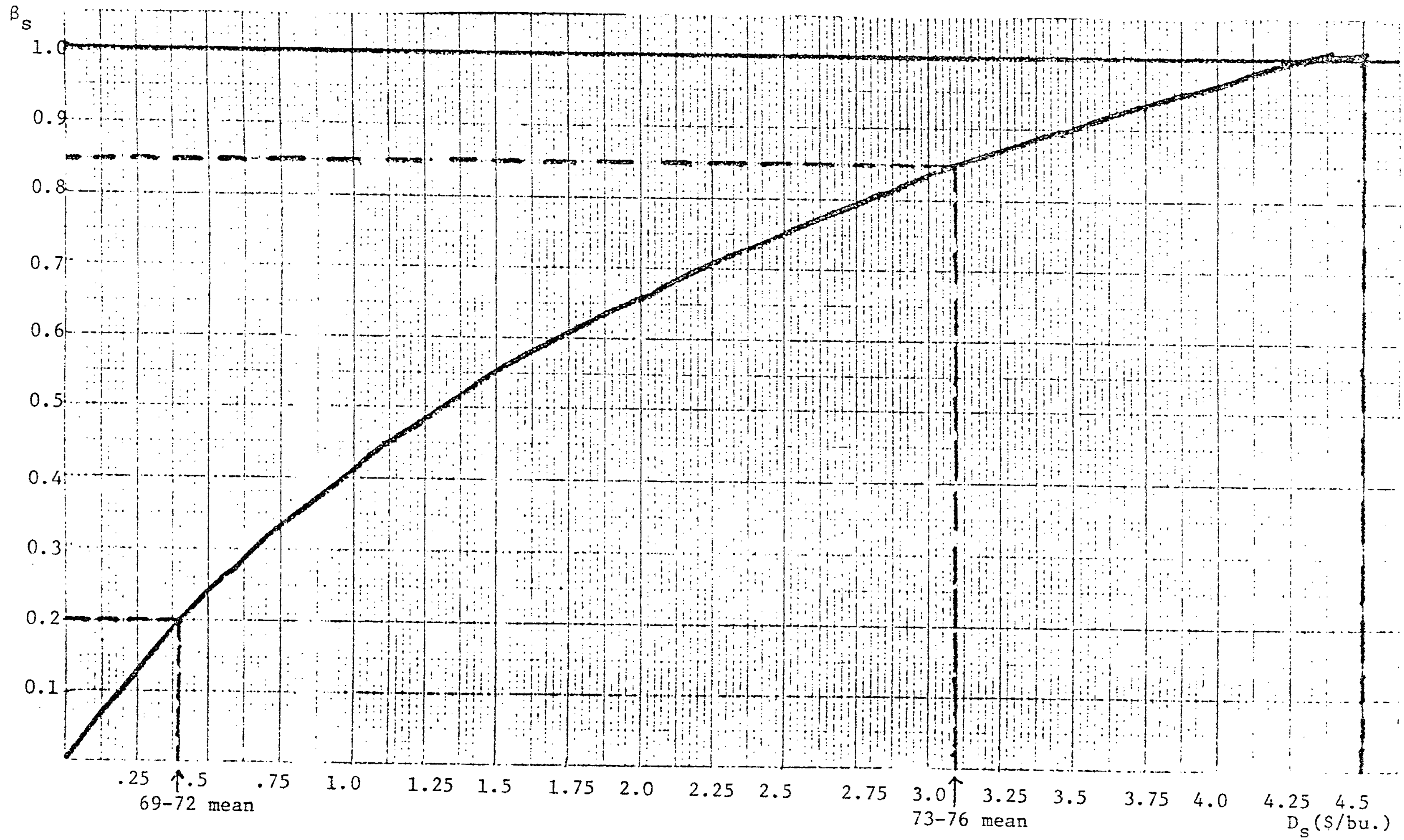

TABLE 2. CORN ACREAGE SUPPORT AND MARKET PRICE ELASTICITIES

Market Conditions \ Price	Corn: Support Price	Corn: Market Price	Soybeans: Support Price	Soybeans: Market Price
Weak[1/]	0.13	0.06	0.05	0.01
Strong[2/]	0.06	0.18	0.01	0.07
Strongest[3/]	0.02	0.29	0	0.10

1/ Based on mean values of data from the 1969-72 period.

2/ Based on mean values of data from the 1973-76 period.

3/ Based on data for the year when the difference between market and support price was largest--1975 for corn and 1977 for soybeans.

SUMMARY

This paper contains a method for measuring non-linearities in producers' reaction to support and market prices. The estimates support the hypothesis that support price changes assume the predominant role under weak market conditions, while market prices are the appropriate signal during the strongest market conditions. Moreover, the results suggest that corn support price influences farmers' decisions when moderate or strong market conditions prevail. Hence, support policy analysis which does not account for this non-linearity could err in predicting the magnitude of farmers' acreage response.

REFERENCES

Evans, S., "Regional Upland Cotton Acreage Response to Economic and Policy Variables," Unpublished manuscript:1977.

Heady, Earl O., Economics of Agricultural Production and Resource Use, Prentice-Hall:1964.

Houck, James P., Martin E. Abel, Mary E. Ryan, Paul W. Gallagher, Robert G. Hoffman, and J. B. Penn., Analyzing the Impact of Government Programs on Crop Acreage. USDA Tech. Bull. 1548, August 1976.

Just, Richard E., Econometric Analysis of Production Decisions with Government Intervention: The Case of California Field Crops, California Agricultural Experiment Station, Giannini Foundation Monograph Number 33, June 1974.

Just, Richard E., "An Investigation of the Importance of Risk in Farmers' Decisions," American Journal of Agricultural Economics. 56(1974): 14-25.

Just, Richard E., "Risk Response Models and their Use in Agricultural Policy Evaluation," American Journal of Agricultural Economics. 57(1975):836-850.

Kmenta, J., Elements of Econometrics, MacMillan Company:1971.

Ryan, Timothy J., "Supply Response to Risk: The Case of U.S. Pinto Beans," Western Journal of Agricultural Economics. Vol. 2 (December 1977), pp. 35-43.

Taylor, A. E., Advanced Calculus, Blaisdell Publishing Company:1955.

APPENDIX A - A NOTE ON THE SHORT RUN DYNAMICS OF ECONOMETRIC RISK MODELS

The purpose of this note is to point out some implications of using econometric risk models for acreage forecasting. In particular, it is shown that large price changes are initially synonomous with increased risk in these representations. Therefore, forecasts based on these devices will suggest that producers under-react to large price increases and over-react to large price decreases in the short run. While the long run equilibrium response to a sustained price change is identical with or without risk terms, short run dynamics depend crucially on the risk term's lag length. To support these abstract arguments, some experiments with risk lag lengths for corn acreage response are presented and short run acreage dynamics are illustrated for the appropriate risk specification.

For some supply analysis it is advantageous to make a qualatative distinction between changes in price levels and changes in price variability (or risk), even though variability is measured in terms of past prices.[1/] Then supply response can be decomposed into (1) a movement

---

[1/] Risk observations are typically measured by the square (or absolute value) of current price about some normal price. Although the interpretation of "normal" varies from author to author, a moving average of past prices is an accepted specification. If one accepts the suggestion that this variation should be deflated by the "normal" price (see Ryan) a reasonable risk observation is

$$Risk_t = \frac{(P_t - MA_t)^2}{MA_t}, \text{ where}$$

$Risk_t$ = risk observation, for period t

P_t = observed price, period t

$MA_t = 1/3 \sum (P_{t-1} + P_{t-2} + P_{t-3})$

(continued)

along the supply curve due to a price change and (2) a shift in the supply curve due to an alteration of price variability.[2/] For example, the transition from a low risk/low price to a high risk/high price era consists of an output expansion effect, as well as a risk-induced backward supply shift. This is illustrated in figure 4. P_o, Q_o and S_o represent the initial price, quantity and supply schedule, respectively. When the price change (to P_1) is accompanied by increased risk, output is given by the supply schedule S_1. Consequently output Q_1 is less than the corresponding no-risk output level (Q_1*).

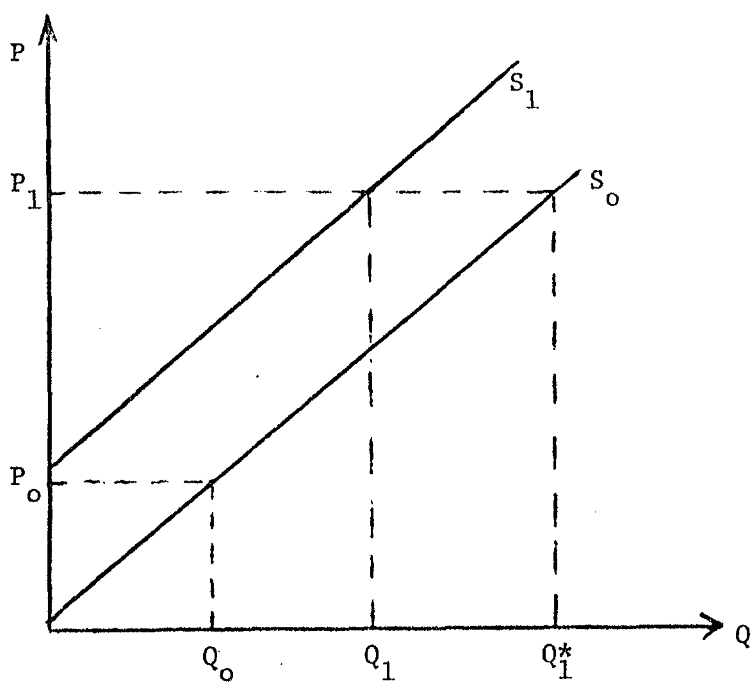

FIGURE 4

[1/](continued) Then the risk variable used in estimating supply response ($Risk_t^*$) is a weighted average of past risk observations

$$Risk_t^* = \sum_{i=1}^{n} w_i \; Risk_{t-i}$$

[2/]See Just, 1975

The relation between price variability measures and the past time path of prices is important, however, when the analysis focuses on short run production dynamics. Indeed, large price changes amount to higher risk levels in the periods immediately following a price change. This is the case provided that (a) risk is measured by the (absolute or squared) deviation of observed price about some "normal" price and (b) the normal price is linked to the price history. Moreover, perceived risk diminishes as "normal" prices adjust to new levels. The case of a large price increase is illustrated in figure (5a). Initially, the price is at P_o and output (Q_o) is defined by the supply schedule S_o. When the price changes to P_1, the first period output is given by S_1. Further, given that "normal" price for subsequent periods adjusts towards the new price level, corresponding supply curves gradually shift back towards the riskless supply schedule (S_o). In short, the expansionary effect of a sustained price <u>increase</u> is offset by increased risk in the short run. However, the short run response to a large price <u>decrease</u> gives rise to supply and risk effects which are reinforcing instead of offsetting. This is illustrated in figure (5b). Again the initial price-quantity combination is given by the supply schedule S_o. When price falls to the lower level (P_1), the supply curve again shifts towards the origin (S_1). As long as the new price level is sustained, production will gradually expand back to (Q_n) on the initial supply schedule (S_o).

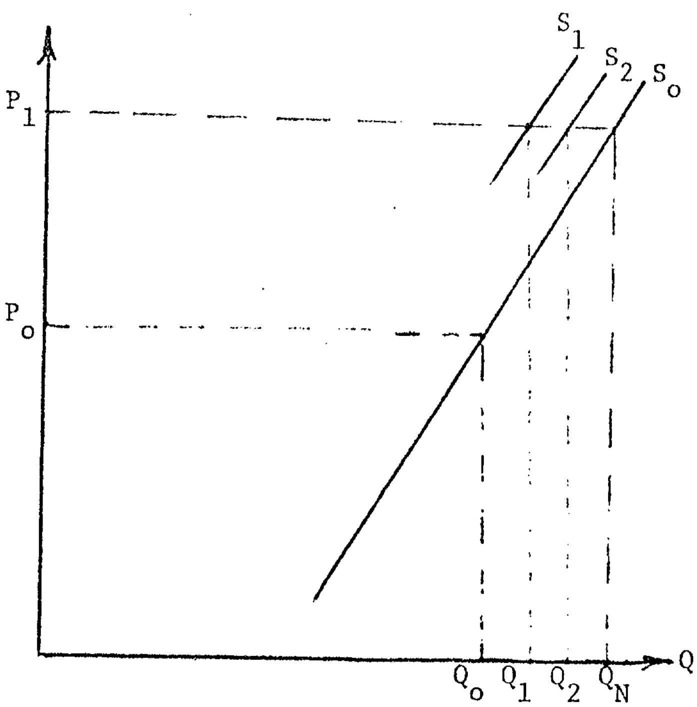

FIGURE 5a - PRICE INCREASE

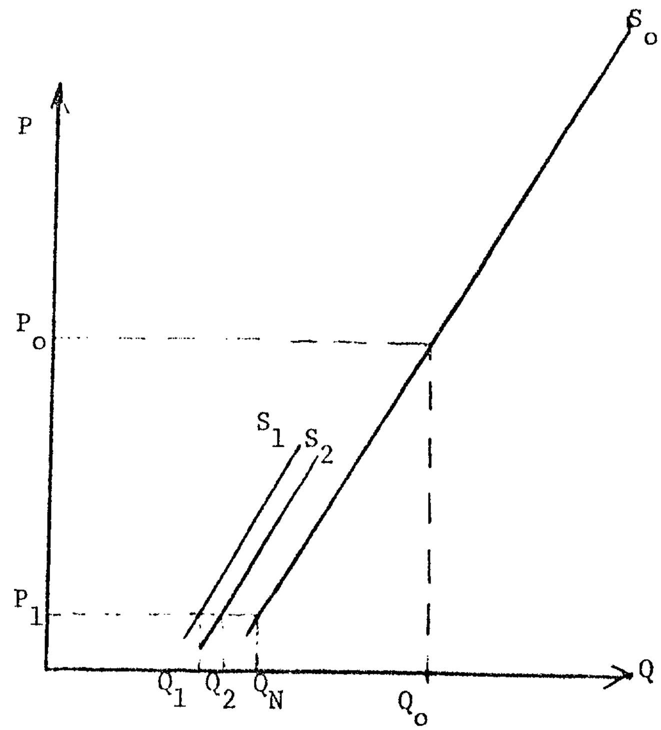

FIGURE 5b - PRICE DECREASE

An examination of the risk definition suggests that the number of periods between a large price change and adjustment to long run equilibrium depends on the lag length for individual risk observations. Other research has employed rather long risk lags. Just (1974b), for example, assumes that the risk lag structure is geometrically declining. Ryan suggests a three year lag with a priori assignment of weights at 1/2, 1/3 and 1/6--this conclusion is based on Just's estimates for California Field crop response (1974b). Even if the lag period is shortened to three years, however, the risk definition (see p. 16) implies a risk adjustment period of ten years. The appropriate lag length, however, is an issue that can be resolved empirically. Indeed, the correct lag length may well vary with the commodity which is analyzed.

Table A1 contains some estimated corn acreage response relationships. These specifications are similar to those presented in the main paper. However, each equation contains a different risk specification. Equations (A.1) excludes the risk term while equations (A.2) through (A.4) feature progressively shorter risk lag lengths. Equation (A.2) contains a three year risk lag, equation (A.3) a two year risk lag and equation (A.4) a single year risk observation. A comparison of the no-risk case with any of the equations with risk terms reveals that a risk term is a significant explanatory variable --the presence of any risk term reduces the standard error. Moreover, a comparison of the alternative risk specification suggests that corn acreage variation is best explained with a one year risk term.

The risk and price response suggested by the estimated corn acreage relation is of particular interest. Accordingly, table 3 illustrates the extent of risk and price effects when the price level changes from \$1.00/bu. to \$2.00/bu. Columns (2) and (3) show the extent of the risk shift and the price induced supply expansion, while the net acreage change is tabulated in column (4). The initial expansion effect 7,162 thousand acres) is offset by a risk effect of 2,736 thousand acres. But output gradually adjusts upwards until the total acreage change between periods 0 and 4 is the same as the price effect in period 1. While complete adjustment takes four years, the strongest risk effects occur for the first three years following the large price increase.

Table A.1 Estimates with Corn Planted Acreage (ACP_t) as the Dependent Variable (OLS)

1954 to 1977 Data — Dependent Variable Mean: 72,993.5

	Constant	$DV66_t$	$ASGPM_t$	DPC_t	$RISK^*_t$	$\frac{PEC_t}{CAC_t}$	Y_c	$\frac{PES_t}{CAS}$	Y_s	R^2	S	D.W.	ESS
1.1) no risk term													
coefficient	79,268.25	4,583.274	-0.30260	-62,719.80		651,724.95	0.902	-78,649.25	0.534	.94405	1859.05	1.461	62,208,997.9
t-value	9.75	3.50	1.43	-5.80		2.47		1.73					
elas@mean				0.092		0.163 1/		0.092 1/					
1.2) three year variance: $RISK^*_t = 1/2\ RISK_t + 1/3\ RISK_{t-1} + 1/6\ RISK_{t-2}$													
coefficient	79,796.85	4,639.58	-0.49600	-64,624.55	-5,624.73	812,996.99	0.902	-66,424.94	0.534	.9544	1726.26	2.116	50,659,358.89
t-value	10.57	3.9	2.25	6.41	1.97	3.14		1.56					
elas@mean				-0.094		0.203 1/		-0.078 1/					
1.2) two year variance: $RISK^*_t = 3/4\ RISK_t + 1/4\ RISK_{t-1}$													
coefficient	80,044.96	4,623.77	-0.51329	-64,372.79	-5,205.13	837,380.14	0.902	-70,427.17	0.534	.9653	1506.45	2.45	38,579,862.73
t-value	12.15	4.45	2.79	7.34	3.23	3.78		1.91					
elas@mean				-0.094		0.209 1/		-0.082 1/					
1.3) one year squared deviation: $RISK^*_t = RISK_t$													
coefficient	78,708.16	4,652.12	-0.48793	-64,479.16	-4,298.54	817,093.76	0.902	-56,595.99	0.534	.9703	1394.39	2.51	33,053,437
t-value	12.9	4.84	2.93	7.94	3.87	4.03		1.64					
elas@mean						0.204 1/		-0.066 1/					

1/ Elasticity wrt expected price. Cost elasticities have equal magnitude but opposite sign.

Variable Definitions

ACP_t : U.S. planted corn acreage (thousands)

$DV66_t$: 1, 1966 to 1972; 0, otherwise

$ASGPM_t$: $\frac{ASGP_t}{}$, 1954 to 1966; ASGP, for previous period, 1961 to present

$ASGP_t$: U.S. Acreage planted to sorghum grains

DPC_t : Corn, effective diversion payment rate (\$/bu.)

PFC_t : Corn, effective price support (\$/bu.)

PMC_t : Corn, U.S. season average price received by farmers (\$/bu.)

CAC_t : Corn, variable costs per acre (\$/acre)

PSS_t : Soybeans, effective price support (loan rate), \$/bu.

PMS_t : Soybeans, U.S. season average price received by farmers (\$/bu.)

CAS_t : Soybeans, variable costs per acre (\$/acre)

$RISK_t$: $\frac{(PMC_{t-1} - MAC_t)^2}{MAC_t}$, where $MAC_t = 1/3(PMC_{t-2} + PMC_{t-3} + PMC_{t-4})$

PEC_t : $PFC_t + \gamma_c [(DC_t + 1) \ln (DC_t + 1) - DC_t]$, where $DC_t = PMC_{t-1} - PFC_t$ 1/

PES_t : $PSS_t + \gamma_s [(DS_t + 1) \ln (DS_t + 1) - DS_t]$, where $DS_t = PMS_{t-1} - PSS_t$ 1/

1/ The estimates in Table 1 utilize assumed γ values: $\gamma_c = 0.902$ and $\gamma_s = 0.534$. The estimates in Table 2 feature estimates of γ values.

Table A2-Risk, Price Effects and Net Corn Acreage Change when Price Changes from \$1.00/bu to \$2.00/bu in period 0.

Period	(1) Risk[1]	(2) Risk Effect[2]	(3) Price Effect[3]	(4) Net Acreage Change[4]
0	0.00	0	0	0
1	1.00	-2,736	+7,162	+4,426
2	0.33	-903	0	+1,833
3	0.07	-219	0	+684
4	0.00	0	0	+219
		Total Acreage Change, Period 0 to 4:		7,162

[1] Risk $= [P_{t-1} - P^A_{t-1}]^2 / P^A_{t-1}$, where $P^A_{t-1} = 1/3(P_{t-2} + P_{t-3} + P_{t-4})$

[2] The magnitude of this shift is given by equation (1.2): Risk effect = -2,736.37 · Risk. Magnitudes are given in 1,000 acres.

[3] Magnitudes again given by equation (1.2). For simplicity variable costs are held at 1975 values and it is assumed that the market price adjustment weight (β) is 0.85. Thus Price effect = +8,426 · Price change · 0.85.

[4] Net acreage change is the sum of the price effect and the change in the risk effect.

APPENDIX B - DATA

Table B contains the data for estimating corn acreage response. Much of this information is available through standard USDA sources. However, the origin of some data, particularly that relating to cost and corn policy, requires elaboration.

The series for corn effective price support and diversion payments were constructed by Houck, et al., in an analysis of government commodity policies for the 1950's and 1960's. This data is extended here for the years covered by the Agricultural Adjustment Act of 1973. This law institutionalized target prices for the purpose of supporting corn farmers' returns with direct cash payments--previously, producer returns were supported solely through the CCC loan program. Target prices have generally exceeded loan rates but target price protection has been limited to a percentage of historical base acreages. Thus, corn effective support price for the 1973-77 period is a weighted average of target price and loan rate--the averaging weight is given by the percentage of planted acreage eligible for target price protection.[1/] The 1973 act also extended the authority to initiate setaside programs. However, supplies were short through the 1977 crop year, so this provision was not invoked. Hence, diversion payment rates through this period are zero.

While commodity cost data is readily available for the inflationary period of the mid-seventies, information from the 1950's and 1960's requires aggregation of more basic data. Corn and soybean variable cost estimates for recent years (after 1973) are taken from USDA Cost of

---

[1/] No target price program has been initiated for soybeans. Producer prices are still supported exclusively with the CCC loan program.

Production surveys. Costs in earlier years are measured with a price index of major variable cost items (fertilizer, fuel, and seed) for corn and soybeans.[2/] The index was converted to cost per acre units with the common year of data (1974) for costs of production and the price index.

[2/] Robert Hoffman (Treasury Department, Office of Raw Materials) graciously provided this information.

TABLE B - DATA FOR CORN ACREAGE EQUATION

	ACP_t	DPC_t	PFC_t	PSS_t	PMC_{t-1}	PMS_{t-1}	CAC_t	CAS_t	$DV66_t$	$RISK_t$	PEC_t	PES_t
1954	82,185	0	1.30	2.22	1.48	2.72	58.92	27.31	0	.005	1.314	2.278
1955	80.932	0	1.33	2.04	1.43	2.46	58.06	26.25	0	.010	1.334	2.082
1956	77,828	0	1.11	2.15	1.35	2.22	56.91	25.20	0	.011	1.134	2.151
1957	73,180	.043	0.96	2.09	1.29	2.18	56.27	25.40	0	.012	1.004	2.092
1958	73,351	.052	0.86	2.09	1.11	2.07	56.45	24.83	0	.045	0.886	2.090
1959	82,742	0	1.12	1.85	1.12	2.00	56.40	24.56	0	.014	1.120	1.856
1960	81,425	0	1.06	1.85	1.05	1.96	55.87	24.56	0	.013	1.060	1.853
1961	65,919	.192	0.84	2.30	1.00	2.13	56.05	26.33	0	.008	0.851	2.308
1962	65,017	.192	0.84	2.25	1.10	2.28	55.49	25.28	0	.002	0.868	2.250
1963	68,771	.112	0.88	2.25	1.12	2.34	55.39	25.87	0	.005	0.904	2.252
1964	65,823	.180	0.81	2.25	1.11	2.51	55.27	26.54	0	.001	0.847	2.267
1965	65,171	.180	0.81	2.25	1.17	2.62	54.82	27.02	0	.003	0.863	2.283
1966	66,347	.248	0.65	2.50	1.16	2.54	55.18	27.24	1	.001	0.751	2.501
1967	71,156	.150	0.84	2.50	1.24	2.75	54.89	27.56	1	.008	0.904	2.515
1968	65,126	.241	0.68	2.50	1.03	2.49	54.22	27.30	1	.022	0.730	2.500
1969	64,264	.241	0.68	2.25	1.08	2.43	52.11	27.81	1	.004	0.744	2.258
1970	66,849	.231	0.68	2.25	1.15	2.35	53.00	27.80	1	.001	0.770	2.253
1971	74,055	.160	1.05	2.25	1.33	2.85	57.78	30.77	1	.054	1.083	2.331
1972	66,972	.260	0.89	2.25	1.08	3.03	60.75	32.01	1	.010	0.905	2.382
1973	71,900	.080	0.83	2.25	1.57	4.37	63.51	41.02	0	.124	1.032	3.014
1974	77,800	0	1.32	2.25	2.55	5.68	88.43	46.34	0	1.128	1.841	3.939
1975	78,170	0	1.32	2.25	3.03	6.64	91.24	47.54	0	1.131	2.221	4.754
1976	84,120	0	1.56	2.50	2.54	4.92	86.39	46.98	0	.068	1.899	3.453
1977	82,740	0	2.00	3.50	2.20	7.32	89.25	48.85	0	.055	2.098	5.095